REMARKS

Claims 1 - 8, 10 - 18, and 23 - 25 are in this application and are presented for reconsideration. By this Amendment, Applicant has amended claims 1, 6, 8, 10, 11 and 17, added new claims 23 - 25 which are based on the specification and made various minor changes to the specification to improve the clarity and style of this application. The new claims do not add any new matter to the application.

Applicant thanks the Examiner for the careful reading of the application, and for providing suggestions.

CLAIM REJECTIONS - 35 USC § 102:

Claims 1 - 7 and 10 - 16 have been rejected under 35 USC § 102(b) as being anticipated by Swickard et al. (U.S. Patent 3,461,495, "Swickard '495", hereinafter).

Swickard '495 discloses a die plate for a plastic pelletizer having radially extending manifolds dividing the plate into arcuate segments for the purpose of applying heat to the die plate. Each segment is formed with parallel heating fluid passageways, some of which open into cavities providing for the return flow of heating fluid. The extrusion orifices are arranged in parallel rolls between the heating passageways.

It is Applicant's position that the prior art as a whole, including the Swickard '495, neither teaches nor suggests the present invention as claimed. In general, the present invention as claimed, including the "thermal stabilization cavities" do not act as a heat insulation between

the water (cooling) and the heated die and do not act as heating or cooling per se. Instead, according to the present invention as claimed, "thermal stabilization cavities" serve as a heat transfer damper. This is a structure that acts to resist the hearing or cooling of the region of the damper. Thermal stabilization takes place due to natural, convective, and radiation heat transfer in the open cavities. These areas are located below the hard surface and around the circumference of a cluster of die orifices. In addition, the thermal cavities according to the present invention as claimed, surround each and every orifice in the die.

This unique heat transfer design enables uniform heat transfer to occur both radially, circumferentially, and longitudinally through the polymer as it flows through each orifice. The present invention as claimed, including the "thermal stabilization cavities" teaches a unique geometry, that allows the heat transfer at each individual orifice. This unique geometry controls heat transfer utilizing a three-dimensional, moving fluid and not as a simple, static, flat insulator as with the current dies.

The purpose of the "thermal stabilization cavities" according to the present invention is to provide three-dimensional heat control so that the polymer in each orifice solidifies just prior to being cut by the pelletizing knife. The die according to the present invention, has been shown to provide this three-dimensional heat control as seen in extremely high quality pellet production in an industrial setting.

<u>BENEFITS OF THE PRESENT INVENTION</u>:

Specifically, there are at least five main benefits of the present invention as claimed

which are listed as follows:

1) First, the "thermal stabilization cavities" according to the present invention insure that the temperature (cooling or heating) of the polymer is uniform at the exit of the orifice hole.

2) Second, the "thermal stabilization cavities" according to the present invention provide unsteady state heat transfer buffers for the pelletizing die.

3) Third, the "thermal stabilization cavities" according to the present invention provide an additional heat transfer control between the polymer, the fluid system, and the water bath.

4) Fourth, according to the present invention, one heat channel across the die (reference number 52 of the application) is sufficient for a uniform heat distribution, as the "thermal stabilization cavities" stabilize the heat transfer.

5) Finally, the mode of function of the "thermal stabilization cavities" is independent from the condition or the thickness of the hard (insulation) face layer.

UNIQUE GEOMETRY OF THE PRESENT INVENTION:

The unique geometry and its relation to the motor function of the thermal stabilization cavities shall be discussed below:

1) Longitudinal "Thermal Stabilizer Cavity" Between Two Orifice Clusters (40):

The longitudinal thermal stabilizer cavity provides a thermal stabilization between two orifice clusters. These longitudinal "thermal stabilizer cavities" stabilize the heat transfer between the water side (cool side) and the polymer side (hot side). Another aspect of these

thermal stabilization cavities is the improvement of the thermal shock resistance during the start-up.

For instance, longitudinal "thermal stabilizer cavities" provides the benefit of avoiding cracks in the hard face layer due to the high thermal loads, especially during start-up. In general, the pelletizing die has a temperature of approximately 250°C and is cooled down by the cooling water in the water chamber. This generates a high temperature gradient or thermal shock during start-up and also permanent high thermal stresses between the orifices when the operation is applied.

In addition, longitudinal "thermal stabilizer cavities" also provides for the benefit of protecting oil inlet cross-over (hot fluid) from the cold water of the water bath. This enables uniform heat transfer and eliminates harmful three-dimensional heat transfer effects (see Figure 6 and the respective specification of the application).

<u>2: Circumferential "Thermal Stabilizer Cavities" For One Orifice Cluster (42)</u>:

Circumferential "thermal stabilizer cavities" provides a thermal stabilizing function around a cluster containing multiple orifices.

These circumferential "thermal stabilizers" insure support to dampen any unsteady-state temperature fluctuations between the orifice clusters.

Each orifice "sees" the same temperature due to equal process condition, as the thermal stabilization cavity" surrounding almost the whole land length.

3: Radially "Thermal Stabilizer" Surrounding One Each Orifice Hole (44):

A radially "thermal stabilizer" geometric shape for each orifice hole provides additional stabilizing benefit as well.

These radially surrounding "thermal stabilizer cavities" support the dampening of any temperature fluctuations between the "neighbor" orifices within one orifice cluster. This is required to make high quality pellets (please refer to Attachment 2 - Designations).

The prior art, Swickard '495, discloses dies having insulation layers or propose the application of an insulation layer that attempt to isolate the cold face. However, this solution does not work due to the low resistance through the thin insulation layer.

The die according to the Swickard '495 transfer heat only by conduction, whereas the present invention as claimed teaches dies that utilize the cavity to transfer heat through conduction, radiation, and convective heat transfer in the cavities.

In addition, the Swickard '495 dies do not control heat transfer between each orifice whereas the present invention as claimed teaches a die that does control heat transfer between each orifice.

Furthermore, Swickard '495, as shown in the prior art (page 4, Figure 5, reference number 70), the insulation material is formed within the cavity. The insulation material can minimize slightly the heat transfer between the water and the heating source by conduction only. This insulation material in the cavity cannot balance the heat transfer between the inside diameter and outside diameter of the die. Therefore, the efficiency of the insulation is reduced by abrasion of the layer during the operation, as the thermal gradient increases.

Claims 10 - 15 have been rejected under 35 USC § 102(e) as being anticipated by Yoshii et al. (U.S. Patent 6,638,045, "Yoshii '045", hereinafter).

The prior art as a whole including the Yoshii '045 neither teaches nor suggests the present invention as claimed.

In general, the heating of the stiffing rib (material between the polymer channels) or the heating in the land length (area) is well known. However, the major problems are to achieve a uniform flow distribution through all heating (cooling) channels. This requirement can only be achieved when the amount of heating (cooling) media is equal in all heating channels. That means, the pressure (drop) balance in the inlet header, outlet header system, and the single heat channel is the critical point and has to be met.

Yoshii '045 discloses a die for manufacturing resin pellets provided with a number of nozzle orifices in the outer surface of the die, that are provided in a plurality of rows of heat channels in the vicinity of the outer surface of the die, and are arranged along the resin channels.

According to the present invention as claimed, the required pressure balance, for a uniform heat distribution, can only be supplied, when an undivided header is applied, as it is realized in the preferred embodiment of the present invention as claimed.

The heating (cooling) media flows in one undivided circumferential inlet header (20) which supplies a uniform flow distribution across the complete die for each single heating (cooling) channel (52). Furthermore, the heating (cooling) media flows back via the connecting channels (55) to an internal circumferential undivided outlet header (22). This internal undivided circumferential header design is shown in Fig. 7 and described in the specification of

the present application.

An additional benefit of an undivided internal header is the reduced number of inlets and outlets, as an external header piping or single connection piping which are not necessary.

Furthermore, the "thermal stabilization cavities" and the heating channels have to be considered as an "interrelation system". That means, the thermal stabilization cavities balance or dampen also each heating (cooling) channel, therefore - for example - three heating channels or other configurations are not necessary, in order to achieve a uniform heat distribution as Yoshii '045 discloses.

It appears, that the header design (part 9 and 10) cannot provide a uniform heating for the heat channels (part 8) according to the Yoshii '045 reference, as they are divided in several smaller headers. For example, when the pressure drops in the connecting pipe etc., and is not uniform, the flow of the heating (cooling) media is unequal.

Based on Fig. 1, with regards to the Yoshii '045, it seems that the length of the channels (part 8) are different. Therefore, the flow through each heat channel (part 8) cannot be uniform due to the different pressure drop of each heat channel.

Furthermore, the pressure drop relation between the header (9 and 10) and the heating channels are not large enough, in order to create sufficient pressure drop for a uniform heating flow distribution across the die.

Regarding Swickard '495, the Swickard '495 discloses a heat channel (50) and the inlet and outlet header (34 and 35) which cannot produce a uniform heating across the die, as the length and/or area in the heating channels and in the inlet/outlet header are different. Therefore,

the flow of heating (cooling) media is not uniform due to the different pressure drop in the heating channels.

CLAIM REJECTIONS - 35 USC § 103:

Claim 8 has been rejected under 35 USC § 103(a) as being unpatentable over Swickard '495.

Swickard '495 discloses a pelletizing die having a pelletizing die member with a die exit side exposed to a cooling fluid and a die entry side for receiving polymer fed thereto.

It is known by the ordinary person skilled in the art that the current polymer inlet design is not calculated by Computational Fluid Dynamics (CFD) according to the current art. That means, the different flow characteristics for various polymers are not properly considered for the design. Therefore, for example, the dimensions of the transition zone land and land length depends on knowledge based on experience, which were gathered through the past decade.

However, the CFD tools are necessary, in order to calculate the optimal polymer inlet design, in order to improve the process performance and finally to predict the process performance.

Normally, the areas between each orifice are machined flat or slightly rounded, in order, for example, to save manufacturing costs or as the knowledge of flow behavior is not available. This inaccurate inlet design can cause flow problems (e.g., elastic flow turbulence) in the transition zone as well as in the land length. The melt fracture was mainly monitored for the polymer HDPE and LLDE, which may be caused by this inaccurate design, as described

previously. Therefore, CFD calculation is applied according to the present invention as claimed, in order to calculate the optimal angle (length) of the transition zone as well as the dimension for the land length, etc..

Based on the CFD calculation, the present invention as claimed teaches an embodiment which do not have any flat areas between the orifices. That means, all areas are razor sharp, which minimizes flow turbulence problems as well as the pressure drop (please refer to Attachment 1 - Photographs).

Yoshii '045 does not teach the technology for avoiding melt fracture or similar flow problems. In addition, the Swickard '495 reference fails to teach the avoidance of melt fracture. In fact, neither the CFD tools were developed nor the detailed knowledge was available at the time that the Swickard '495 was patented.

Therefore, Yoshii '045 and Swickard '495 do not provide any specific technical solution, explanation, and detailed proposal about avoiding the melt fracture or similar flow problems.

Furthermore, Applicant finds no incentive in either Yoshii '045 nor in Swickard '495 which would lead a person to all the structural features of the pelletizing die as taught by the present invention as claimed. In fact, the prior art does not recognize these problems and directs the skilled artisan in a different direction. In explicitly, in a direction where melt fracture or similar flow problems are ignored all together.

Claims 17 and 18 have been rejected under 35 USC § 103(a) as being unpatentable over Yoshii '045 in view of Mallay (U.S. Patent 4,167,386, "Mallay '386", hereinafter).

It is Applicant's position that the claims 17 and 18 are not suggested by the combination of art of Yoshii '045 in view of Mallay '386.

In general, all "thick" hard face layers in accordance with the prior art references Yoshii '045 and Mallay '386 are required for thermal insulation as well as for the wear protection of the die plate.

It has to be pointed out that, even if an abrasion of die plate is not expected, all common pelletizing die designs are based on the application of a thick hard faced layer, in order to provide a thermal insulation between the cool water and the heated (warm) areas.

Normally, abrasion is caused during operation by knives and polymer, the thickness of the insulation layer is reduced by and by, which has a drastic effect on the mode of function (purpose) of the insulation layer. The purpose of the insulation is to minimize the heat transfer between the cooler water and the heating zone. Normally, the thick hard faced layer has to replace, when the thickness is smaller than, for example, one millimeter.

A certain thickness of the hard face layer is required, in order to produce "good" pellets or to maintain the structural integrity of the die plate. The process performance depends on the thickness of the surface and condition of the hard face, in explicitly, rounded edges at the orifices, cracks, etc. reduce the number of goods pellets.

A thick insulation layer or hard face layer is not required for the present invention as claimed as "thermal stabilization cavities" are applied.

Because of the "thermal stabilization cavities", only the present invention as claimed allows the application of a hard surface which can be thinner than, for example, 1 millimeter

(please refer to Attachment 3 - Overview Hardness).

To test the above hypothesis, various hard face testing had been performed. Specifically, a detailed investigation report was performed, in order to find the optimal technology for the hard face of a pelletizing die. The investigation activities contained theoretical and practical evaluations of various hard face applications.

INVESTIGATION OF OPTIMAL THICKNESS:

Based on the detailed investigation and evaluation, the following brief overview can be provided:

1) General - Thick Hard Face Layer (Fused TiC Or Brazed TiC) (Titan Carbide):

High thermal loads are generated during start-up and operation, as the die plate temperature is about 250°C and the temperature of the cooling water is about 50°C. Specifically, the start-up procedure causes extraordinary high thermal loads, which causes cracks. In addition, low cycle fatigue is to be considered.

Rounded edges at the orifice exit caused already during drooling, when the hard face material is deposited or formed established (fused TiC and brazed TiC) are course grained. This rounded edges cause misshapen pellets as well.

Furthermore, all thick layers can have cracks due to different thermal expansion of the base plate and the thick hard face layer.

2) General - Thin Layer Technology:

In general, all kinds of thin layer technologies can be applied for the present invention as claimed, such as ceramic, CVD, PVD or other. The following detailed technical information refers to the PVD layer technology.

The application of PVD layer allows the present invention as claimed to produce a hard faced layer which covers the complete cutting area without any space or any cracks.

Furthermore, the PVD layer is also applied in the orifice hole directly. Please note, that the diameter of the orifice hole is the maximum depth of the PVD layer - length of wear protection. Therefore, an excellent wear protection of the orifice edge - due to the polymer swell, is applied. Therefore, the edges on the orifice exit are maintained sharply.

This means, due to the flow characteristics of the polymer, the orifice exit is highly loaded by the forces due to the polymer swelling and also by the forces of the knives during cutting (please refer to Attachment 4 - Polymer Swelling at the Die Exit).

The PVD layer does not crack with regards to the thermal loads, as normally seen by using thick hard face layer application which are thicker than, for example, 1 millimeter.

The complete range of thin layer technologies, especially the CVD or PVD technology can be applied for the present invention as claimed. The thin layer technology is only an abrasion protection of the die plate and is not a thermal insulator as described in all other prior art as quoted in the Office Action.

According to the present invention, the harness of the PVD layer is between 2,000 HV and 3,000 HV, but there are other preferred embodiments wherein, the harness and thickness

will be increased (please refer to attachment 5 - PVD hard face technology, for example).

In addition, regarding the polymer inlet design, the braising process based on gold material cannot be applied to TiC or other hard metal braising.

Yoshii '045 in combination with Mallay '386 clearly fail to teach and fail to suggest the combination of the invention. Absent a teaching or suggestion of the important feature of the invention, the combined references clearly do not direct the person of ordinary skill in the art toward the combination as claimed.

There must be some suggestions or teachings in the prior art as a whole which would lead the person of ordinary skill in the art to provide the combination as claimed. As the prior art as a whole fails to direct the person of ordinary skill in the art toward the claimed combination, the invention should be considered not anticipated, non-obvious, and thus patentable.

As the prior art as a whole fails to suggest a combination of features as claimed, Applicant respectfully requests that the Examiner favorably consider the claims as now presented in view of the discussion above.

It is Applicant's position that all claims are now allowable. Should the Examiner determine that issues remain that have not been resolved by this response, the Examiner is requested to contact Applicant's representative at the number listed below. Favorable action is requested.

Respectfully submitted
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Enclosed: Associate Power of Attorney/Associate Power of Attorney
Attachment 1 - Photographs
Attachment 2 - Designations
Attachment 3 - Overview Hardness
Attachment 4 - Polymer Swelling at the Die Exit

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BY: ______________________ DATE: June 29, 2004